

**MAGNITUDE OF ANEMIA AND ASSOCIATED FACTORS WITH ITS  
SEVERITY AMONG CHILDREN AGED 6 MONTHS TO 14 YEARS ADMITTED  
TO GONDAR UNIVERSITY HOSPITAL, NORTHWEST ETHIOPIA**

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**Magnitude of Anemia and Associated Factors with Its Severity  
among Children Aged 6 Months to 14 Years Admitted to Gondar  
University Hospital, Northwest Ethiopia**

**By**

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## ABSTRACT

**Background:**Anemia is a major public health problem in both developed and developing countries, contributing significantly to morbidity and mortality in children. This study is aimed to determine the magnitude of anemia and associated factors with its severity among children aged between 6 months and 14 years admitted to Gondar University Hospital.

**Methods:** Hospital based cross-sectional prospective study was conducted between January and June, 2016. 176 subjects were eligible to be included in the study. To study the associated factors with severe anemia, socio-demographic and clinical information were obtained through structured questionnaire interviews and laboratory investigations. Anemia was defined using WHO criteria. Data were cleaned and analyzed SPSS version 20 and bivariate followed by multivariate regression was done to see the correlates of associated factors with severe anemia. The adjusted Odds Ratio (AOR) with corresponding 95% confidence interval (CI) was estimated to show the strength of association. A P-value of  $<0.05$  was used to declare statistical significance.

**Results:** In this study, 106 (60.2%) were male and 113 (64.2%) subjects were rural residents. The magnitude of anemia was also 14.1% of which half (7.05%) was severe anemia. In multivariate, low monthly family income ( $<1000$ ETB) ( $P=0.007$ ), moderate and severe wasting ( $P=0.034$  and  $P<0.001$  respectively), thrombocytopenia ( $P=0.022$ ), and blood film positive for malaria ( $P=0.012$ ) were significantly associated with severe anemia. The study also indicated that severe anemia had 4.3 times more likely to risk for death at discharge than non-severe anemia (p-value 0.013).

**Conclusion:**The study revealed that relatively higher magnitude of severe anemia associated with low socio-economic status, malnutrition and blood film positive for malaria infection.

**Keywords:** Severe anemia, children, Ethiopia

# 1. INTRODUCTION

## 1.1 Background

Anemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development. The World Health Organization (WHO) has estimated that more than 2 billion people worldwide are suffering anemia, especially children and women of reproductive age[1]. The global estimate of childhood anemia indicates that 293.1 million of children under five years (6–59 months) 47.4%,and 25.4% of school age children, a combined 600 million [2]. Africa and Asia are found with sever public health importance of anemia [3]. It is considered to be a major public health problem with prevalence of 67%, equivalent to 83.5 million children in Sub-Saharan Africa [4]. Anemia is one of the largest killers of children admitted to hospitals in Sub-Saharan Africa [3].Anemia can be managed without blood transfusion but even where blood transfusions are available there is a significant case fatality rate of 6-18% [5]. In East Africa, approximately 75% of under-five and 40% of school age children are suffering from anemia [2].

Severe anemia is an important cause of morbidity and mortality in many parts of the world. The burden is higher in Sub Saharan Africa where it has been associated with an increased risk of morbidity and mortality [6]. The problem is alarming in Sub-Saharan African Countries such as Kenya 48.9% [7]; Mali 55.8% [8] and Tanzania 79.6% [9]. According to the WHO 2011 report, the prevalence of anemia in Ethiopia for under- five children was 50% of which severe anemia account 2.9% [4].

According to the Ethiopian 2011 DHS report, the overall prevalence of anemia among children under-five years (6–59 months) was 44.2 %, of which21.4% mild, 20.4% moderate and 2.5% was severe anemia [10].

Anemia can negatively affect cognitive development, school performance, physical growth, and immunity. Anemia is a multi-factorial health problem in which the risk factors vary in different settings; could be nutritional (iron, folate, and vitamin B12 deficiencies), clinical (infectious diseases such as malaria, helminth infections, tuberculosis, HIV/AIDS and general inflammatory disorders, hematological malignancies and chronic diseases like sickle cell disease.), socioeconomic factors (educational low

household income), and demographic factors (age, gender, and family size, maternal factors) [5, 10-12].

World Health Organization (WHO) considers anemia prevalence over 40% as a major public health problem, between 20 and 40% as a medium-level public health problem, and between 5 and 20% as a mild public health problem [11]. High prevalence of anemia and its consequences for children's health, especially for their growth and development, have made anemia an important public health problem, given the difficulty in implementing effective measures for controlling it [9].

Although anemia remains a widespread public health problem in most developing countries, like Ethiopia, there are very few studies on the prevalence and severity of anemia among children in Gondar area. Because of its impact on cognitive development and physical growth, studies on the magnitude of anemia and its severity among children have paramount importance.

Gondar University Hospital (GUH) monthly reports indicate that many children are admitted with anemia but as of the principal investigator's knowledge the true burden remains unknown. Severe anemia is among the causes for admission and mortality in the pediatric wards. Although mild and moderate anemia is associated with long term and debilitating side effects little attention is given to these conditions. This study aims to determine the magnitude of anemia and associated factors with its severity among children aged between 6 months and 14 years admitted to GUH Pediatrics wards. The findings of this study will help us to set prevention programs and update our treatment protocols for proper management and follow up care of anemia of all severity.

## **1.2 Research Objectives**

### **General Objective**

To determine magnitude of anemia and associated factors with its severity among children aged between 6 months and 14 years admitted to Gondar University Hospital.

### **Specific Objectives**

- To determine the magnitude of anemia between 6 months and 14 years admitted to GUH.
- To determine associated risk factors for severe anemia among anemic children between 6 months and 14 years admitted to GUH.
- To determine the short-term outcome of severe anemia among participants.



## **2. METHODS**

### **2.1 Study Design and Setting**

An institutional based cross sectional study was conducted in prospective for six months from January 1 to June 30, 2016 at Gondar University Hospital. Gondar town is found in Northwest Ethiopia 725km far from the capital city Addis Ababa. Its altitude is 2200meters above sea levels. Gondar University medical college is the oldest medical school in Ethiopia established as Public Health College in 1954 and it is a long serving teaching hospital with both undergraduate and postgraduate studies serving the people of Northern part of Ethiopia. It receives referrals from an area that encompasses 17 million people in the Amhara Region. Gondar University Hospital Pediatrics ward has six sections; emergency, main ward, malnutrition, oncology, PICU and NICU wards with 15 pediatricians, 13 residents and around 50 nurses. Annually around 4500 patients admitted to six pediatrics wards with different cases.

### **2.2 Study Population**

All children aged between 6 months and 14 years admitted to Gondar University Hospital.

#### **Inclusion Criteria**

All anemic children aged between 6 months and 14 years who were admitted to Gondar University Hospital.

#### **Exclusion Criteria**

- Patients with trauma for the past 2 months.
- History of surgery within two months.

### **2.3 Study Sample**

Census study that included all anemic children of ages between 6 months and 14 years was carried out.

### **2.4 Study Variables**

#### **Dependent Variable**

The presence of anemia by severity was taken as the dependent variable.

## **Independent Variables**

Patient age, sex, residence, birth weight, history of chronic illness, child weight, breast feeding practice including duration, type of complementary feeding and age at introduction, monthly family income, family history of bleeding tendency, parental type, caretaker's education, caretaker's occupation, presence of malaria parasites, presence of malnutrition, stunting, child HIV status, RBC morphology, WBC count, platelet count.

## **2.5 Data Collection**

All anemic children aged between 6 months and 14 years admitted to GUH were approached for caretaker's consent and assent. Data collection was done by the principal investigator.

Data was collected using pre-tested structured questionnaire, such as socio-demographic information of the children regarding patient's age, sex, residence, history of chronic illness that is history of blood transfusion or being treated for anemia, birth weight, whether the child was born prematurely, breast feeding practices including duration, age at introduction of other type of food, type of complementary food in the first year of life. Additional information on family history of bleeding tendency, family monthly income, presence of single, both or no parents, caretaker occupation and education level were also obtained.

For clinical information, detailed history and thorough physical examination of these children were performed. Anthropometric measurements including weight using standard beam balance for each age group, height or length and mid upper arm circumference were taken for assessing nutritional status to classify into malnourished and non-malnourished. Malnourished and stunted children also categorized into mild, moderate and severe based on standard reference [13].

Laboratory examinations, such as complete blood count using an automated CBC machine Sysmex kx-21 (Japan), blood film for malaria parasitology, peripheral morphology, HIV screening was done for the purpose of investigation and management of the patient. Patients were managed according to national guidelines and standard textbooks for their respective cases.

## 2.6 Data Entry and Analysis

The collected data was cleaned and checked for completeness; then coded and entered using SPSS version 20 for analysis. Descriptive analysis was done and a multivariate logistic regression analysis was applied to determine the associations of risk factors with severe anemia. The independent variables were included into the model based on prior evidence in the literatures and their effect in current analysis. Independent variables with a p-value of 0.2 and less during the bivariate test were included for the final model.

In multivariate model, the adjusted Odds Ratio (AOR) with corresponding 95% confidence interval (CI) was estimated to show the strength of association. A P-value of <0.05 was used to declare statistical significance.

## 2.7 Operational Definition of terms:

**Anemia:** was defined by hemoglobin concentration (g/dl) in accordance with the WHO standard for children depending on their age [1].

Population	Non –Anemia	Mild	Moderate	Severe
Children 6 - 59 months	11.0 or higher	10.0-10.9	7.0-9.9	<7.0
Children 5 – 11.9 years	11.5 or higher	11.0-11.4	8.0-10.9	<8.0
Children 12 - 14 years	12.0 or higher	11.0-11.9	8.0-10.9	< 8.0

**Thrombocytopenia** defined as platelet count less than 150, 000/mm<sup>3</sup> [13].

**Thrombocytosis** defined as platelet count greater than 400,000/mm<sup>3</sup> [13].

**Stunting:** Height for age less than 5<sup>th</sup> centile is stunted while greater than 5th centile is normal [13].

**Wasting:** standard deviation below median weight for height (WFH), mild - 80-90%, moderate – 70-80%, severe < 70% [13].

**Severe acute malnutrition:** weight for height less than 70%, MUAC< 11cm (6months-5years) or bilateral pitting edema [14].

## 2.8 Ethical Considerations

This study was approved by the University of Gondar Institutional Review Committee. After the goals and objectives of the study explained to the study participants, informed consent and ascent was obtained from each subject.

### 3. RESULTS

#### 3.1 Socio-demographic characteristics of the study participants.

A total of 176 study participants were enrolled out of 1249 admitted patients. Hundred-six (60.2%) of them were male the male-female ratio was 1.51:1 and 113 (64.2%) of them were rural residents. The majority of the participants 107(60.8%) were under five years old and nearly all, 167(94.9%) born on-term and 166 (94.3%) of them were feed breast milk at least for six months. Nearly half 87(48.4%) of the caretakers earned an average monthly income of below 1000 ETB (US\$1 = 22.24 Ethiopian Birr). Educational background of the caretakers, majority 114 (64.8%) had no formal education and the rest attended primary school, 46(26.1%), secondary school, 12 (6.8%); and very few 4(2.3%) college degree. The occupation of the caretakers of the children, the majority 109(61.9%) were farmers, followed by housewives 34(19.3%). Most study children, 142(80.7) were living with their both parents while 33(18.8%) were living with their single parents (**Table 1**).

#### 3.2 Nutritional status and clinical characteristics of study participants

A total of 187 study participants (from 1249 admitted in the study age range) were recruited, out of which 11 didn't fit to inclusion criteria and excluded from the study. Only 176 children were analysed in this study. The magnitude of anemia in the current study was 14.1% with different degree of severity from mild, moderate and severe anemia which accounts 22.7%, 27.3% and 50.0% respectively. The mean haemoglobin concentration level was  $7.6 \pm 2.7$  g/dL with standard deviations (SD).

This study also showed severe acute malnutrition in 44.3% of anemic children and chronic malnutrition like stunting was identified in 35.8% of anemic children. The hematologic profiles of the participants show leukopenia, low MCV and thrombocytopenia in 12.5%, 54.0% and 33.5% respectively. This study also revealed that the blood film positive for malaria in 9.1% of anemic patients. Of those anemic children, 10.2% were died in the hospital.

**Table 1:** Socio-demographic characteristics of study children with anemia at Gondar University Hospital, January- June, 2016.

<b>Variable</b>	<b>N (%) (n=176)</b>
<b>Sex</b>	
Female	70 (39.8)
Male	106 (60.2)
<b>Age Group (in years)</b>	
0.5 –4.9	107 (60.8)
5 – 11.9	43 (24.4)
12 – 14	26 (14.8)
<b>Address/Residence</b>	
Urban	63 (35.8)
Rural	113 (64.2)
<b>Delivery Status</b>	
Preterm	9 (5.1)
Term	167 (94.9)
<b>Breast Feeding Practice</b>	
Yes	166 (94.3)
No	10 (5.7)
<b>Type of Complementary Feeding</b>	
Cow's milk	92 (52.3)
Tea	14 (8.0)
Gruel	60 (34.1)
Other	10 (5.7)
<b>Monthly Family Income (ETB)</b>	
<1000	87 (48.4)
1000 – 5000	62 (35.2)
> 5000	27 (15.3)
<b>Caretaker education</b>	
No formal	114 (64.8)
Primary	46 (26.1)
Secondary	12 (6.8)
College/University	4 (2.3)
<b>Caretaker Occupation</b>	
Farmer	109 (61.9)
Housewife	34 (19.3)
Daily laborer & others	14 (8.0)
Gov't worker	12 (6.8)
Merchant	7 (4.0)
<b>Parent Status/Type</b>	
No parent/orphan	1 (0.6)
Single parent	33 (18.8)
Both parents	142 (80.7)

**Table 2:** Clinical Characteristics of studychildren with anemia at Gondar University Hospital, January-June, 2016.

Variable	N (%) (n=176)
<b>Anemia Magnitude</b>	<b>176/1249 (14.1%)</b>
Mild	40 (22.7)
Moderate	48 (27.3)
Severe	88 (50.0)
<b>Wasting (Weight for Height)</b>	
Normal	47 (26.7)
Mild malnutrition	20 (11.4)
Moderate malnutrition	31 (17.6)
Severe malnutrition	78 (44.3)
<b>Stunting (Height for Age)</b>	
Normal	56 (31.8)
Mildly stunted	57 (32.4)
Moderately stunted	35 (19.9)
Severely stunted	28 (15.9)
<b>MCV Level</b>	
Normal	70 (39.8)
High	11 (6.3)
Low	95 (54.0)
<b>WBC Level</b>	
Normal WBC	92 (52.3)
Leukocytosis	62 (35.2)
Leukopenia	22 (12.5)
<b>Platelets count</b>	
Normal	82 (46.6)
Thrombocytosis	35 (19.9)
Thrombocytopenia	59 (33.5)
<b>Blood film for malaria</b>	
Positive	16 (9.1)
Negative	160 (90.9)
<b>Condition at Discharge</b>	
Dead	18 (10.2)
Disappeared/went against	9 (5.1)
Alive	149(84.7)
<b>Mean haemoglobin( in g/dl ±SD)</b>	<b>7.6 ± 2.7</b>

SD- standard deviation

### 3.3 Factors associated with the severe anemia

In bivariate analysis, factors associated with severe anemia were rural residents [p-value=0.042, 95% CI(1.1-3.6),OR 1.9];monthly family income< 1000 birr [p-value <0.001, 95% CI (8.4-45.1),OR 19.5]; noformal caretaker's education level [p value 0.03, 95% CI(1.1-4.4),OR 2.2];mild, moderate and severe wasting (wt/ht) [p-vale<0.001, 95%CI [11.8-89],OR 32.4], [p-value <0.001, 95%CI (7.5- 92),OR 26.3 ] [p-vale <0.001, 95% CI(20.2-330.3),OR 81.7] respectively;mild, moderate and severe stunting [p-value0.024, 95%CI (1.2-12.5), OR 3.9], [p-value 0.011, 95% CI (1.4-12.4), OR 4.1] and [p-value <0.001, 95% CI (3.7- 35.5), OR 11.5] respectively; blood film positive for malaria [p-value 0.045, 95% CI (1.1-10.7), OR 3.3], thrombocytosis [p-value < 0.001, 95% CI (2.2-13.5), OR 5.4] and thrombocytopenia [p-value <0.001, 95% CI (2.6-11.8),OR 5.6].

In bivariate analysis, age and sex didn't associate with severe anemia but males (29.5%) and younger children (6 -59 months) (30.1%) had higher prevalence of severe anemia than females (20.5%) and those 12-14 years old (6.8%).

In multivariate analysis, the factors significantly associated with severe anemiaincluded low family income [p-value 0.007, 95% CI (1.8-36.5),AOR 8.1], moderate and severe wasting [p-value 0.034, 95% CI (1.2-67.8),AOR 8.9 andp-value <0.001, 95% CI (25.7-4223.2),AOR 329.5 respectively], thrombocytopenia [p-value 0.022, 95% CI (3.9-170.3), AOR 25.9], and blood film positive for malaria [p-value 0.012, 95% CI (2.2-614.0), AOR 36.6] (Table 3).

In the current study, the bivariate analysis showed significant association between rural residence,low caretaker's education level and overall stunting with severe anemia,but in multivariate analysis these factors were not significant probably due to confounders[p-value 0.232, 95% CI (0.1-1.7) AOR 0.4], [p-value 0.044, 95% CI (0.2-3.7), OR 0.9]and [p-value 0.826 95% CI (1.4-79.4) AOR 10.6] respectively (Table3).

In multinomial logistic analysis, the short-term fatality rate of severe anemia was observed [p-value 0.013, 95% CI (1.4-13.7) OR 4.3]. It indicated that severe anemia had 4.3 times more likely to risk for death than mild to moderate anemia.

**Table 3:** Factors associated with the severe anemia at Gondar University Hospital, January-June, 2016.

RISK FACTOR	ANEMIA SEVERITY		UNADJUSTED		ADJUSTED	
	Severe N (%)	Mild to mod. N (%)	COR [95%CI]	P-value	AOR [95%CI]	P-value
<b>Residence</b>						
Urban	25 (39.7)	38 (60.3)	1			
Rural	63 (55.8)	50 (44.2)	1.9 [1.1-3.6]	<b>0.042</b>	0.4 [0.1-1.7]	0.232
<b>Monthly Income</b>						
>=5000	0 (0)	27 (100)	--			
1000-5000	14 (22.6)	48 (77.6)	1			
< 1000	74 (85.1)	13 (14.9)	19.5 [8.4-45.1]	<b>&lt;0.001</b>	8.1[1.8-36.5]	<b>0.007</b>
<b>Caretaker Education</b>						
College/Univ.	0 (0)	4 (100)	--			
Secondary	7 (58.3)	5 (41.7)	1			
Primary	17 (37.0)	29 (63.0)	0.9 [0.3-3.1]	0.884	0.1 [0.01-0.9]	0.919
No formal	64 (56.1)	50 (43.9)	2.2 [1.1-4.4]	<b>0.030</b>	0.9 [0.2-3.7]	<b>0.044</b>
<b>Wasting (Wt/Ht)</b>						
Normal	10 (21.3)	37 (78.7)	1			
Mildly	5 (25.0)	15 (75.0)	32.4 [11.8-89]	<b>&lt;0.001</b>	4.8 [0.7-33.6]	0.110
Moderate	3 (9.7)	28 (90.3)	26.3 [7.5- 92]	<b>&lt;0.001</b>	8.9 [1.2-67.8]	
Severe	70 (89.7)	8 (10.3)	81.7 [20.2-330]	<b>&lt;0.001</b>	<b>0.034</b> 329.5[26-4223]	<b>&lt;0.001</b>
<b>Stunting</b>						
Normal	16 (28.6)	40 (71.4)	1			
Mildly	30 (52.6)	27 (47.7)	3.9 [1.2-12.5]	<b>0.024</b>	1.2 [0.1-12.4]	0.828
Moderately	19 (54.3)	16 (45.7)	4.1 [1.4-12.4]	<b>0.011</b>	1.4 [0.2-12.7]	0.746
Severely	23 (82.1)	5 (17.9)	11.5 [3.7-35.5]	<b>&lt;0.001</b>	0.8 [0.1-7.4]	0.826
<b>Platelet Count</b>						
Normal	30 (36.6)	52 (63.4)	1			
Thrombocytosis	13 (37.1)	22 (62.9)	5.4 [2.2-13.5]	<b>&lt; 0.001</b>	10.6 [1.4-79.4]	0.075
Thrombocytopenia	45 (76.3)	14 (23.7)	5.6 [2.6-11.8]	<b>&lt;0.001</b>	25.9 [3.9-170.3]	<b>0.022</b>
<b>Blood film for malaria</b>						
Negative	76 (47.5)	84 (52.5)	1			
Positive	12 (75.0)	4 (25.0)	3.3 [1.1-10.7]	<b>0.045</b>	36.6 [2.2-614.0]	<b>0.012</b>
<b>Condition at Discharge<sup>¥</sup></b>						
Alive	65 (76.5)	80 (55.2)	1			
Disappeared	6 (66.7)	3 (33.3)	2.5 [0.6-10.2]	0.215		
Dead	14 (77.8)	4 (22.2)	4.3 [1.4-13.7]	<b>0.013</b>		

¥- Anemia severity was taken as independent variable against condition at discharge using multinomial logistic regression to determine the association with case fatality rate.

COR-Crude/unadjusted odds ratio for bivariate analysis,

AOR-Adjusted odds ratio for the final multivariate model

CI- Confidence interval



## 4. DISCUSSION

Anemia is a major public health problem associated with many risk factors [2]. This was the first study conducted at GUH to measure different factors thought to be associated with severe anemia. The findings of this study indicate that anemia is a major public health problem among children between 6 months and 14 years admitted to Gondar University Hospital.

The observed magnitude or burden of anemia in this study (14.1%) is lower than other hospital-based studies conducted in India (90.2%) among 0-14 years of age children [15], in Tanzania (77.2%) among under-fives [16], in Malawi (61.8%) among under-fives [17], in Nigeria (49.2%) among under-five children [18], in India (45.7%) among ages of 6 months to 5 years and in Wag-Himra Zone, Northeast Ethiopia (66.6%) among under-two years children [19], but it is slightly higher than the study conducted at Jimma University Hospital, Southwest Ethiopia (6.6%) of the children below 12 years of age [20] and in California (11.1%) among 12-36 months-old children [21]. These differences in the magnitude of anemia may be due to difference in the study area, sample size, the study subjects' age range and other associated factors.

The prevalence of severe anemia (hemoglobin < 5g/dl) in a number of hospitals based studies ranges from 8% to 29% and was associated with a case fatality rate of 9-18 % [22]. In the current study also, half of the anemic children (7.05%) were severely anemic which is nearly similar with the study conducted in Pakistan (7.3%) among under 12 years hospitalized children [12]. However, this value is lower than other hospital-based studies reported in Tanzania (27.7%) among under-fives [16] and in Nigeria (9.7%) among under-fives [18], on the other hand, it is higher than the study conducted in India (5.26%) among children 0-14 years and (5.0%) among ages of 6 months to 5 years [15, 23]. This high prevalence of severe anemia may be due to as a referral hospital, it is likely that the patients were highly selected, with the more severe forms of anemia being seen in this setting.

In this study, low family income, moderate and severe wasting, thrombocytopenia and blood film positive for malaria strongly associated to develop severe anemia among

children. The association of thrombocytopenia with severe anemia may be linked with the presence of cancer and malaria patients in the study participants.

The current study reveals that children of low family income (<1000ETB) had 8.1 times more likely to be severely anemic as compared to those getting over 1000ETB per month. Thus, this finding is in line with other hospital-based studies conducted in Ethiopia ( $p < 0.05$ ) [19-20], Pakistan (72.6% poor) [12] and Tanzania ( $p = 0.031$ ) [22]. But this result is in contrary with the studies in Tanzania ( $p = 0.669$ ) [16] and Nigeria ( $p = 0.7$ ) [24].

Stunting and wasting are long-term and short-term indicators of malnutrition, the implication of the results was that under-nourished children experience higher risk of developing severe anemia as compared to nourished children. The current study also showed that moderate and severely wasted children had 8.9 and 329.5 times more likely to have severe anemia respectively as compared with nourished children.

This result is similar with other studies done in Ethiopia [19-20], Pakistan [12], Peru [25], Tanzania [22], and Brazil [26]. But this result is in contrary with some studies in Tanzania [16] and Nigeria [24].

Several studies have also reported that malaria is an important cause of severe anemia [22, 27, 28-30]. It contributes to anemia through red blood cell lysis, organ sequestration and destruction of erythrocytes, phagocytosis of uninfected and infected red blood cells and dyserythropoiesis [31]. In this study malaria was strongly associated with severe anemia. Blood film positive for malaria children had 36.6 times more likelihood to have severe anemia than negative for malaria. This result is similar with other studies conducted in Papua New Guinean children ( $p = 0.001$ ) [32], Tanzania ( $p < 0.001$ ) [16, 22], Malawi ( $p = 0.001$ ) [33], Nigeria ( $p = 0.03$ ) [18, 34] and in Ethiopia [35].

Severe anemia is of special concern as it poses a significant health and mortality risk. As Stevens *et al.* stated that, anemia can be a direct (when severe) or indirect (when mild or moderate) contributor to death [36]. And the study conducted by Brabin *et al.* revealed that a substantially increased risk of death in severely anemic children [8]. This study also indicates that severe anemia had 4.3 times more like to risk for death than non-severe anemia [ $p$ -value 0.013, 95% CI [1.4-13.7] OR 4.3]. So this result is similar with the two reports from, Kenyan hospitals, severely anemic children showed a 12-fold increased risk of mortality [37-38].

## **5. CONCLUSION**

In conclusion, the magnitude or burden of anemia in children admitted at Gondar University Hospital is fairly mild but half is accounted to severe anemia due to highly selected patient admissions as a referral hospital.

The finding of this study shows that low socio-economic status, malnutrition and malaria were the main contributing factors for children with severe anemia. Severe anemia was also found to be the major contributor for death of admitted children.

So the causes of severe anemia in GUH admitted children can, therefore, be considered as comprising two main categories, namely low socio-economic status (low income and wasting) and infection (malaria), which are both associated with a mainly hypo proliferative anemia.

The present study confirms that severe anemia in GUH admitted children is multifactorial and suggests that low family income and severe and moderate wasting are the most important contributors.

### **Limitations of the study**

As a referral hospital, it is likely that the patients were highly selected, with the more severe forms of anemia being seen in this setting. There was limitation in diagnostic facilities to determine causes of anemia. This included unavailable Serum ferritin, folate, and vitamin B12 levels, investigations for thalassemia, G6PD deficiency and bone marrow biopsy for those with possible bone marrow failure.

## **6. RECOMMENDATION**

Anemia is a global problem and requires proper understanding of its associated factors, so that effective measures can be taken to combat this disorder. Proper foods, rich in nutrients, iron supplements are some of the essential requirements. Regular checkups for the children under-five years must be conducted so that the effective actions can be taken as early as possible.

Therefore, I suggest that the approach to anemia control and treatment guideline should be prepared. Blood transfusion should be easily available and with different preparation including packed RBC.

In national or regional level, continuous health education program should be developed after assessing caretakers' knowledge, practices and beliefs on anemia in children.

These data show that severe anemia is multifactorial in GUH admitted children, strongly associated with under-nutrition and certain common infections, and potentially preventable through improved nutrition, and intermittent preventive antimalarial treatment.

Moreover, further research that will assess other associated factors like Serum ferritin, folate, and vitamin B12 levels, investigations for thalassemia, G6PD deficiency and bone marrow biopsy, will be recommended to explore the problem in depth and provide maximal care for these children.

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## APPENDIX-I --RESEARCH QUESTIONNAIRE

### Participants Particulars

1. Date of recruitment.....
2. Chart number .....
3. Code number.....
4. Address.....
5. Age.....
6. Sex: 1. Male 2. Female
7. Pre term: 1.Yes 2.No
8. Birth weight: .....unknown .....
9. History of chronic diseases: 1.Yes 2.No 3. I don't know
10. If yes mention.....
11. Breast feeding practice: 1. Yes 2. No
12. If Yes for how long was on exclusive breastfeeding.....months
13. At what age was started weaning: .....months
14. Type of complimentary/ supplementary feeding:
  1. Cow's Milk: 1. Yes 2. No
  2. Tea: 1. Yes 2. No
  3. Gruel: 1. Yes 2. No,
  4. Other: 1. Yes 2. No if yes mention.....
16. Any drugs given within one month period: 1.Yes 2.No .....
17. If Yes mention the drugs.....
18. Blood transfusion in the past 2 months: 1. Yes 2. No
19. If Yes how many times: .....
20. Any illness the child had experienced for the past two weeks.....
21. Family history of bleeding tendency ...1.yes.....2.no .....
22. If yes which part of the family members has bleeding tendency?
  1. female 2. male 3. both
23. Monthly family income: .....
24. Care taker Education level 1. None 2. Primary 3. secondary 4. college
25. Caretaker occupation.....
26. Relation with the caretaker.....
27. If Parents 1. Single parent 2. both parents
28. Family size.....

## **Physical Examination**

### **Vital signs:**

- 29. Temperature (degrees centigrade): ..... ..
- 30. Respiratory rate (breaths /min): .....
- 31. Heart rate (beats/min): .....

### **Anthropometric measurements**

- 32. Body weight (kg): ..... ..
- 33. Height (cm): .....
- 34. MUAC (cm): .....
- 35. Nutritional status: 1. Malnourished 2. Not malnourished
- 36. If malnourished 1.mild malnutrition 2.moderate malnutrition 3.severe malnutrition
- 37. If stunted 1.mild 2.moderate 3.severe

### **Physical features related anemia**

- 37. Conjunctiva pallor 1.Yes2.No
- 38. Gingival hypertrophy 1.Yes 2.No
- 39. Angular cheilitis 1.Yes2.No
- 40. Jaundice 1. Yes 2. No

### **Lymphoglandular system**

- 42. Lymphadenopathy 1.yes 2.no

### **Respiratory**

- 43. Respiratory distress sign 1. Yes 2.no
- 44. Crepitations: 1. Yes 2. No

### **Cardiovascular**

- 45. Distended neck vein /raised JVP 1.yes 2.no
- 46. Murmur 1.Yes 2.No

### **Abdomen**

- 47. Liver 1. Enlarged 2. Not enlarged
- 48. If yes is it tender 1.yes 2.no
- 49. Spleen 1. Palpable 2. Not palpable

### **Integumentary system**

- 50. Petechiae: 1. Yes 2. No
- 51. Purpura: 1. Yes 2. No
- 52. Echymosis: 1. Yes 2. No

53. Pale skin: 1. Yes 2. No
54. Pale mucosa: 1.Yes 2.No
55. Other: Describe: .....

### **Laboratory Findings:**

56. Hb.....
57. RBC.....
58. MCV.....
59. MCH.....
60. MCHC.....
61. WBC count .....
- a. lymphocyte percentage .....
- b. neutrophil percentage.....
62. Platelet count 1.Normal 2.thrombocytopenia 3.thrombocytosis
63. Blood film for malariaparasite: 1.positive.....2.negative.....
64. If positive parasite count/µl.....
65. Stool microscopy.....

### **Peripheral smear**

66. RBC morphology 1. normal 2.abnormal
67. If abnormal specify.....
68. RBC size 1. Normocytic 2.Microcytic 3.Macrocytic 4.Anisocytosis
69. Chromic state 1. Normochromia 2.Hypochromia
70. Nucleated RBCS 1. Yes 2. No
71. Target cells 1. Yes 2. No
72. Blast cells

### **HIV status**

73. Mother HIV status: 1.positive 2.negative 3.unknown
74. If positive in 73 is the mother on ARV 1.Yes. 2 No 3.NA
75. Child HIV status: 1. Negative 2 Positive 3.Unknown
76. If positive in 75 is the child on ARV 1.Yes 2.No 3.NA.
77. CD4 count if the child is HIV positive: .....
78. Bone marrow result if available: .....
79. Condition at discharge 1.Alive 2. Dead 3.dissapeared/went against
80. Final diagnosis: .....